## CLAIM AMENDMENTS

1. (original) An optical module comprising:

a surface light receiving type or a surface light emitting type optical element mounted on a predetermined substrate;

at least one spacer mounted on said substrate; and

an optical fiber array having a plurality of optical fibers buried therein substantially in parallel with one another with a predetermined pitch therebetween, said optical fiber array being mounted to said substrate with said spacer interposed between the substrate and the optical fiber array such that the optical fibers are opposed to a plurality of light receiving elements or light emitting elements of the optical element mounted on the substrate respectively, and said optical fiber array being mounted to said substrate with alignment between the end surfaces of the optical fibers and the light receiving elements or light emitting elements carried out by image recognition thereof.

2. (original) The optical module as set forth in claim 1, wherein the alignment by the image recognition is carried out on the basis of image information on the surface of the substrate on which the optical element and the spacer have been mounted as well as image information on the surface of the optical fiber array at the side thereof not opposed to the optical element.

3. (presently amended) The optical module as set forth in claim 2, wherein the optical fiber array is provided with engagement means for coupling the optical fiber array with an optical connector <u>to</u> each other.

4. (original) The optical module as set forth in claim 3, wherein the engagement means provided on the optical fiber array is a recess or through hole into which a pin-like projection provided on the optical connector fits.

5. (original) A method of assembling an optical module comprising the steps of:

mounting a surface light receiving type or a surface light emitting type optical element on a predetermined substrate;

carrying out alignment between a plurality of light receiving elements or light emitting

elements of said optical element and the end surfaces of a plurality of optical fibers of an optical fiber array by image recognition thereof, the end surfaces of the optical fibers being opposed to the light receiving elements or light emitting elements; and

mounting the optical fiber array to the substrate with at least one spacer interposed between the substrate and the optical fiber array in the state that the alignment between the light receiving elements or light emitting elements and the end surfaces of the optical fibers is being kept.

6. (original) The method as set forth in claim 5, wherein the alignment by the image recognition is carried out on the basis of image information on the surface of the substrate on which the optical element and the spacer have been mounted as well as image information on the surface of the optical fiber array at the side thereof not opposed to the optical element.

7. (original) The method as set forth in claim 5, wherein the optical array is fixed to the spacer mounted on the substrate in the state that the alignment between the light receiving elements or light emitting elements and the end surfaces of the optical fibers is being kept.

8. (new) An optical module comprising:

a plurality of surface light receiving type or surface light emitting type optical elements mounted substantially in parallel with one another with a predetermined pitch therebetween on a substrate;

at least one spacer mounted on said substrate; and

an optical fiber array having a plurality of optical fibers buried therein substantially in parallel with one another with the same predetermined pitch therebetween as that of the optical elements mounted on the substrate, said optical fiber array being mounted to said substrate with said spacer interposed between the substrate and the optical fiber array such that first ends of the optical fibers exposed at a first surface of the optical fiber array which faces the substrate are opposed to the optical elements mounted on the substrate respectively, and the respective optical fibers of said optical fiber array are aligned in lines with the respective optical elements mounted on said substrate by carrying out image recognition of an image of second ends of the optical fibers exposed at a second surface of the optical fiber array which is opposite to the first surface thereof and an image of the optical elements mounted on the substrate.

9. (new) The optical module as set forth in claim 8, wherein the alignment by the image recognition is carried out on the basis of image information on the surface of the substrate on which the optical element and the spacer have been mounted as well as image information on the surface of the optical fiber array at the side thereof not opposed to the optical element.

10. (new) The optical module as set forth in claim 9, wherein the optical fiber array is provided with engagement means for coupling the optical fiber array with an optical connector to each other.

11. (new) The optical module as set forth in claim 10, wherein the engagement means provided on the optical fiber array is recesses or through holes into which projection pins provided on the optical connector fit.

12. (new) A method of assembling an optical module comprising the steps of:

mounting a plurality of surface light receiving type or surface light emitting type optical elements substantially in parallel with one another with a predetermined pitch therebetween on a substrate;

aligning in lines the optical elements with a plurality of optical fibers buried in an optical fiber array substantially in parallel with one another with the same predetermined pitch therebetween as that of the optical elements mounted on the substrate by image recognition of an image of the optical elements mounted on the substrate which faces a first surface of the optical fiber array and an image of second ends of the optical fibers which are exposed at a second surface opposite to the first surface of the optical fiber array, so that first ends of the optical fibers which are exposed at the first surface of the optical fiber array are respectively opposed to the optical elements; and

mounting the optical fiber array to the substrate with at least one spacer interposed between the substrate and the optical fiber array in a manner such that a predetermined gap is provided between the respective optical elements and the opposing first ends of the respective optical fibers while the alignment between the optical elements and the optical fibers is being kept.

13. (new) The method as set forth in claim 12, wherein the aligning by image recognition is carried out on the basis of image information on the surface of the substrate on which the optical element and the spacer have been mounted as well as image information on the surface of the optical fiber array at the side thereof not opposed to the optical element.

## DISCUSSION

Claims 1-7 are pending in the application and are rejected under 35 USC § 103 as being unpatentable over US patent 6,374,004 (referred to as "Han") in view of US patent 6,455,944 (referred to as "Kato").

In particular, the Office Action indicates Han teaches all that is claimed except "image recognition as an alignment means," that it is widely known to use image recognition for passive alignment, that Kato discloses the use of image recognition for passive alignment, and that it would have been obvious to use image recognition for passive alignment of devices to minimize optical losses.

*Claims 1-4*

Applicant respectfully traverses the rejection of claims 1-4 because Han and Kato, either alone or in combination, do not disclose all features of the structure recited in claim 1.

Han discloses an "optical subassembly" with a plurality of optical fibers 10 and a plurality of opto-electronic devices 14 that are to be in communication with the fibers. An optics block 20 provides at least one optical element between each opto-electronic device 14 and a corresponding fiber 10. Preferably, the optics block 20 is spaced apart from the opto-electronic devices 14 by a spacer 15. (see col. 3 lines 48-56, the figures and the claims)

Kato discloses an "optical assembly" with an optical device chip 10 that is mounted on a substrate 20, an optical fiber 30 disposed in a V-shaped groove 26 in the substrate, and an optical waveguide 23 that provides an optical coupling between the optical device 10 and the optical fiber 30. (see col. 8 lines 14-19 and col. 8 line 64 to col. 9 line 6)

The optical module set forth in claim 1 comprises the following (this an abbreviated description of the actual claim elements):

> (a) a receiving- or emitting-type optical element mounted on a substrate;
>
> (b) a spacer mounted on the substrate
>
> (c) an optical fiber array (plurality of optical fibers) mounted on the substrate with the spacer interposed between the optical fiber array and the substrate such that the optical fibers are opposed to and aligned with a plurality of light-emitting or light-receiving elements in the optical element

The structure of the optical module in claim 1 differs from the structure of optical subassembly disclosed in Han and the optical assembly disclosed in Kato:

(1) Neither Han nor Kato discloses a spacer mounted on the same substrate on which the optical element is mounted. Instead, Han discloses a spacer that is mounted on the optical element. Kato does not disclose any spacer.

(2) Neither Han nor Kato discloses a spacer that is interposed between the substrate and the optical fiber array. Instead, Han discloses a spacer that is (optionally) interposed between the optical element and the optical fibers. As mentioned above, Kato does not disclose a spacer.

(3) Neither Han nor Kato discloses a spacer on which the optical fibers are mounted such that the optical fibers and the optical element are opposed to and aligned with one another as recited in claim 1. Instead, the spacer disclosed in Han (along with the optics block) provides separation between the optical element and the optical fibers that is substantially parallel to the axis of the optical element and the optical fibers and does not provide separation to achieve alignment. In Han, alignment is achieved by an intermediate optics block rather than by the spacer.

Furthermore, Han discloses an optical subassembly having a structure that requires an optics block 20 between opto-electronic devices 14 and optical fibers 10, and Kato discloses an optical assembly having a structure that requires an optical waveguide 23 between optical device chip 10 and optical fiber 30. In contrast to what is disclosed in Han and in Kato, the optical module recited in claim 1 does not recite an optics block, optical waveguide or any other component that is between the optical element and the optical fibers. The omission of an element with a retention of the missing element's function is indicia of non-obviousness. See MPEP 2144.04, II B.

Claims 2-4 are dependent on claim 1 and add further limitations that are not disclosed or suggested by either Han or Kato.

*Claims 5-7*

Applicant respectfully traverses the rejection of claims 5-7 because Han and Kato, either alone or in combination, do not disclose all features of the steps recited in method claim 5.

Han discloses a method in which the optics block 20 is first aligned with the spacer 15 (or alternatively with the opto-electronic devices 14 if the spacer 15 is not used). This alignment is achieved using fiducial marks on the various components. Thereafter, the optics block 20 (along with the opto-electronic devices 14) is aligned with the optical fibers 10 by using fiducial marks and/or mechanical mating features.

The method of assembly set forth in claim 5 comprises the following steps (this an abbreviated description of the actual claim steps):

(a) mounting a receiving- or emitting-type optical element on a substrate;

(b) aligning a plurality of light-emitting or light-receiving elements in the optical element with a plurality of optical fibers in an optical fiber array by image recognition of the plurality of light-emitting or light-receiving elements and end surfaces of the plurality of optical fibers; and

(c) mounting the optical fiber array to the substrate using at least one spacer interposed between the fiber array and the substrate to keep the alignment.

This method differs from the method disclosed in Han in a number of respects:

(1) One difference is recognized in the Office Action; Han does not disclose or suggest passive alignment by image recognition.

(2) Han does not disclose mounting the optical fibers on a spacer that is interposed between the fiber array and the substrate.

The method of assembly recited in claim 5 also differs from what is disclosed in Kato. Kato discloses a method in which an optical device chip 10 is passively aligned with a substrate 20 using image recognition of high-contrast index marks formed on the chip 10 and the substrate 20; thereafter, the chip 10 is bonded to the substrate. The method recited in claim 5 differs from what is disclosed in Kato in several respects.

(1) Kato does not disclose or suggest image recognition of light-emitting or light-receiving elements, and does not disclose or suggest image recognition of the end surfaces of optical fibers. Instead, Kato teaches the need to use high-contrast index marks that are specially formed on the chip 10 and the substrate 20 for that purpose.

(2) Kato does not disclose or suggest using image recognition to align an optical device with the end of an optical fiber. Instead, Kato teachings aligning an optical device chip 10 with a substrate 20.

(3) Kato does not disclose or suggest a method in which optical fibers are bonded to a substrate after alignment is achieved. Instead, Kato teaches bonding the optical device chip after alignment is achieved.

(4) Kato also does not disclose or suggest mounting optical fibers on a spacer.

Claims 6-7 are dependent on claim 5 and add further limitations that are not disclosed or suggested by either Han or Kato.